THE RELATIONSHIP BETWEEN THE ICON INDEX AND THE DENTAL AND AESTHETIC COMPONENTS OF THE IOTN INDEX

Aim: To determine the malocclusion complexity and orthodontic treatment need in urban Iranian schoolchildren using the Index of Complexity, Outcome, and Need (ICON) and the Index of Orthodontic Treatment Need (IOTN) and to also assess the relationship between these indices.

Methods: The study sample comprised 502 individuals (253 girls and 249 boys, 11 to 14 years of age), of whom one girl and five boys already had an orthodontic appliance at the time of the survey. In those individuals not wearing orthodontic appliances (n = 496), the definitive treatment need (ICON > 43) and compartments of the ICON were defined and compared between sexes. The Aesthetic Component and Dental Health Component (DHC) of the IOTN were also recorded. Scatter plots and Spearman rank correlation coefficients were used to explore the relationships between the ICON and DHC and the Aesthetic Component (AC) of the IOTN. Results: According to ICON, DHC (IOTN), and Aesthetic Component (IOTN), 46.6%, 36.1%, and 17.9%, respectively, of the studied children needed orthodontic treatment; however, only 1.1% wore an appliance. In terms of complexity, 26.4% of the studied individuals were considered to have a difficult or very difficult malocclusion. With regard to treatment needs, significant correlations existed between the ICON scores and DHC (IOTN) (r = 0.93) and between the ICON scores and the esthetic component (IOTN) (r = 0.96). The threshold for treatment need was lower in the ICON than in the IOTN. Of the children who were classified in the borderline category of the IOTN (DHC = 3), 52.0% were in need of treatment according to their ICON score (ICON > 43). No sex difference was found for treatment need (ICON > 43, P > .05) and treatment complexity (P > .05). Conclusion: According to the ICON, 46.6% of the Iranian schoolchildren need orthodontic treatment. ICON is a good substitute for the IOTN, yet it results in a lower treatment-need threshold. World J Orthod 2010;11:43–48.

Key words: orthodontic need, treatment-need threshold, complexity, ICON, IOTN
A satisfactory estimate of the need and demand for orthodontic treatment in any population is a prerequisite for developing and organizing a meaningful service. In this context, several indices have been proposed that not only measure the prevalence of malocclusions but also try to objectively quantify their severity. Examples include the Occlusal Index of Summers, the Handicapping Malocclusion Assessment Record of Salzmann, the Dental Aesthetic Index, the Index of Orthodontic Treatment Need, the Peer Assessment Rating (PAR), and the Norwegian Orthodontic Treatment Index. These indices intend to objectively measure the severity of malocclusions, either as deviations from normal occlusion or in terms of perceived treatment need. They usually have a cut-off point to differentiate between those individuals who require and do not require therapy.

Unfortunately, these indices are not always comparable. The ICON was developed by 97 practicing orthodontists from nine countries. It is unique in incorporating an esthetic score. Because it not only defines treatment need but also assesses malocclusion severity, it offers a significant advantage over other indices.

To these authors’ knowledge, there is no other study of the malocclusion complexity and the orthodontic treatment need in Iranians using the ICON. The primary aim of the present study was to evaluate these two aspects in 11- to 14-year-old Iranian schoolchildren. The secondary aim was to assess the relationship between the ICON and the IOTN (DHC and Aesthetic Component [AC]).

SUBJECTS AND METHODS

This cross-sectional study was approved by the Research Ethics Committee and Faculty of Community Dentistry, School of Dentistry, Isfahan University of Medical Sciences.

The target population was schoolchildren aged 11 to 14 years in Isfahan, Iran. By this age, the permanent canines and premolars have erupted, so the majority of potential orthodontic problems are evident.

Exclusion criteria for this study were subjects with craniofacial anomalies (clefts and syndromes) and non-Iranian nationals. To ensure random selection, the 502 children (253 girls and 249 boys) were chosen from six public schools from different parts of Isfahan.

IOTN

The IOTN ranks malocclusions in terms of the significance of various occlusal traits for an individual’s dental health and perceived esthetic impairment, with the intention of identifying those individuals who would most likely benefit from an orthodontic treatment. The index has an Aesthetic and Dental Health Component. The Aesthetic Component consists of 10 color photographs showing dentitions that differ in attractiveness: grade 1 represents the most attractive and grade 10 the least attractive. The Dental Health Component (DHC) incorporates the various occlusal traits considered to increase the morbidity of a dentition. There are five grades within the DHC: grades 1 and 2 represent no need for treatment, grade 3 represents borderline need, and grades 4 and 5 represent a need for orthodontic treatment.

ICON

The ICON consists of five components: the Aesthetic Component, assessment of maxillary and mandibular crowding/spacing, crossbites, anterior open bite/overbite, and sagittal posterior occlusion. These can be measured either on study casts or in a patient’s mouth. It takes approximately 1 minute to appraise this index.

The extra- and intraoral examination using a mirror, ruler, and a digital sliding caliper was conducted by one orthodontist (A.F.) who was calibrated for the IOTN and ICON.

Statistical analysis

All data were processed with SPSS 16 (SPSS), calculating descriptive statistics such as means and standard derivations.
Treatment need (ICON score > 43) for the two sexes was compared using the Fisher Exact test. The individual ICON components (easy, mild, moderate, difficult, and very difficult) in both sexes were compared with the chi-square test. Also, the confidence intervals for the average ICON scores in both sexes were calculated. The relationships between the ICON scores and the esthetic component and DHC of the IOTN were explored with scatter plots and Spearman rank correlation coefficients. Any P value < .05 was interpreted as significant.

**RESULTS**

The mean ICON score was 44.6 (95% CI, 42.4 to 46.8) (Table 1, Fig 1). The mean ICON scores for boys and girls were 46.8 ± 24.8 and 42.5 ± 24.8, respectively. Treatment was needed (ICON score > 43) in 46.6% of the sample with no significant difference between the two sexes (Table 2). Table 3 summarizes the distribution of the subjects within the treatment complexity compartments. Though a higher proportion of boys was grouped into the very difficult compartment (14.8%) as
compared to girls (9.1%), the differences did not vary significantly between sexes ($P > .05$). Overall, the difficult or very difficult complexity grade was found in only 26.4% of the studied population.

According to the esthetic component of the IOTN, 17.9% of the studied children showed a definite need for orthodontic treatment, 36.1% a borderline need, and 46.0% a slight or no need (Table 4). According to the DHC of the IOTN, 36.1% had a definite need for orthodontic treatment, 20.2% a borderline need, and 43.8% showed a slight or no need for treatment.

Figures 2 and 3 show the scatter plots of the ICON scores vs the esthetic component and the DHC of the IOTN. For any given IOTN grade, there was a range of possible ICON scores. The association between the ICON scores and the scores of the DHC was significant ($r = 0.93; P < .01$) as was the one between the ICON and the esthetic component ($r = 0.96; P < .01$). The threshold limit for treatment need according to the ICON (> 43) was lower than that for the DHC (4 and 5) and the esthetic component (8 to 10). Table 5 and the relation between an ICON > 43 in individuals with a borderline treatment need according to the IOTN (DHC = 3). Herein lies the main difference between the two indices: 52.0% of the children classified in the borderline category of the IOTN were in need of treatment according to the ICON (> 43). Reviewing the treatment needs in children with an ICON > 43 and a DHC of 3 (IOTN) shows that 36.0% of them had an Aesthetic Component of 5 and 86.5% an Aesthetic Component of 6.

**DISCUSSION**

At the age of 11 to 14 years, not too many children will have commenced orthodontic therapy. However, their permanent dentition is almost complete, thus allowing an accurate occlusal assessment. The sample used in this study was reasonably diverse and represented a fairly broad range of treatment needs, thus allowing a substantiated assessment of the relationship between ICON and IOTN.
Because of the shortcomings of the IOTN and the PAR Index, the ICON was developed.\textsuperscript{17} The IOTN and PAR Index have been validated against only UK orthodontists’ conceptions, and they therefore do not represent the international opinion. The PAR Index has been criticized further for its undue leniency of residual extraction spaces, unfavorable incisor inclination, and remaining rotations. The need for treatment does not necessarily equate to the complexity of the therapy.\textsuperscript{20} Therefore, there is a need to assess the complexity to identify the most appropriate treatment setting for the patient (general practice, hospital, or specialized practices) inform the patient of the likelihood of success, and identify cases that will take more time to treat.

The ICON is a relatively new index that will likely be used more frequently in the future. It has been shown to be reliable and valid for appraising orthodontic treatment need.\textsuperscript{21, 22}

<table>
<thead>
<tr>
<th>AC</th>
<th>ICON &gt; 43</th>
<th>ICON ≤ 44</th>
<th>Total</th>
</tr>
</thead>
<tbody>
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<td>11 (100.0)</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>32 (64.0)</td>
<td>18 (36.0)</td>
<td>50</td>
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<tr>
<td>6</td>
<td>5 (13.5)</td>
<td>32 (86.5)</td>
<td>37</td>
</tr>
<tr>
<td>&gt; 6</td>
<td>0</td>
<td>2 (100.0)</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>48 (48.0)</td>
<td>52 (52.0)</td>
<td>100</td>
</tr>
</tbody>
</table>

The treatment need estimates of this study were higher than those reported in previous surveys in which the ICON was used.\textsuperscript{23, 24} Note that results should not be compared if they were derived from different indices, such as the IOTN, as hinted at by Daniels and Richmond.\textsuperscript{17}

The ICON identifies all subjects with DHC grades of 4 and 5 in need of treatment. In this study, it identified a greater proportion of the sample in need of treatment (46.6%) compared to the DHC (36.1%) and the Aesthetic Component (17.9%). This was also expressed in the statement of Daniels and Richmond during the introduction of the ICON.\textsuperscript{17} Therefore, definite need under the ICON is not necessarily equivalent to definite need under the IOTN. Theoretically, it is possible to calculate ICON scores of > 43 in individuals with an Aesthetic Component < 5 by virtue of the remaining four components of the ICON. In a previous study comparing the IOTN and the ICON, Fox et al\textsuperscript{25} used study models for extracting the IOTN scores. Therefore, it is possible that using the study model protocol of IOTN will result in higher scoring occlusal traits, such as DNC 4, regardless of the presence of displacement. As a result, the percentage of cases classed as having a definite need for treatment was similar for the IOTN and ICON.

The National Health Service in the United Kingdom currently provides funding for all patients with a DHC of 3 and an aesthetic component of 6 and above. In this study, the ICON identified 86.5% of the children in that category (AC = 6) as being in need of treatment and 100.0% if the DHC and the aesthetic component were higher than the aforementioned values. Therefore, the ICON can be a good substitute to the currently used indices in the United Kingdom and other countries with similar healthcare systems. In terms of complexity, in slightly more than a quarter of the studied children, the therapy was considered difficult or very difficult. This indicates the high level of expertise required to treat these individuals.

The good correlation between the ICON and DHC in this study can be partially explained by the diverse ordinal scale of the DHC (a range between 1 and 5).\textsuperscript{26} The very high correlation between the ICON and the aesthetic component is not surprising considering that ICON is heavily based on the Aesthetic Component of the IOTN. The lower level of correlation reported by Fox et al\textsuperscript{25} could be because these authors used a relatively small sample of 55.

Considering that 1.1% of the 11- to 14-year-olds were already wearing an orthodontic appliance at the time of this
survey and that 36.1% were still in need of treatment (according to the IOTN DHC) brings the overall treatment need to 37.2%. The corresponding figure using the ICON would be 47.7%. All in all, the ICON and the results of this study are useful for public health planning.

CONCLUSION

Based on the ICON, 46.6% of this study sample needed orthodontic treatment. According to the DHC (IOTN) and the Aesthetic Component (IOTN), the respective numbers were 36.1% and 17.9%. In terms of complexity, 26.4% of the treatments were considered difficult or very difficult. Statistically significant correlations existed between the ICON and the DHC (r = 0.93) and the Aesthetic Component (IOTN) (r = 0.96). Overall, the ICON had a lower treatment need threshold compared to the IOTN. No sex differences were found between girls and boys for treatment need (ICON > 43, P > .05) and treatment complexity (P > .05).

REFERENCES